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ABSTRACT

This study occurred as part of a project entitled Collaboration for the Enhancement of Mathematics Instruction (CEMI). CEMI is a partnership involving middle and high school mathematics teachers, university mathematicians, university mathematics teacher educators, and pre-service secondary mathematics teachers. The purpose of the study is to examine how a multimedia case is perceived by four groups of people with diverse backgrounds and common interest in mathematics teaching and learning--pre-service secondary mathematics teachers, in-service secondary mathematics teachers, university mathematicians, and mathematics teacher educators. This research also considers the interactions of these groups as they meet both online and face-to-face to discuss the multimedia case. The multimedia case study "Making Weighty Decisions" was used to assist the four cultures in understanding each other's perspectives on mathematics teaching and learning prior to beginning collaborative lesson planning. (KHR)

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Talking About Mathematics Teaching: An Examination of the Use of a Multimedia Case to Stimulate the Conversation

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Introduction

Multimedia case studies of teaching provide us with opportunities to follow a lesson from planning and implementation to analysis of students' work and teachers' reflections. Video tapes or clips allow us to "see" into the classroom, while support materials (lessons plans, teacher journal entries, samples of student work, etc.) provide context and often encourage us to reflect on our own beliefs and practices about teaching and learning. Multimedia cases are instances of practice to which broader issues of teaching and learning can be related.

Research on the use of multimedia cases is in its initial stages, with research thus far focusing mainly on benefits to pre-service teachers (Barron & Goldman, 1994; Lampert & Ball, 1998). Our research is somewhat unique in that it examines how a multimedia case is perceived by four groups of people with diverse backgrounds and a common interest in mathematics teaching and learning – pre-service secondary mathematics teachers, in-service secondary mathematics teachers, university mathematicians, and mathematics teacher educators. This research also considers the interactions of these groups as they meet both online and face-to-face to discuss the multimedia case.

Our research occurred as part of a Lucent Technologies Foundation funded project entitled Collaboration for the Enhancement of Mathematics Instruction (CEMI). CEMI is a partnership involving middle and high school mathematics teachers, university mathematicians, university mathematics teacher educators, and pre-service secondary mathematics teachers. The purpose of the project is to engage these four cultures in Lesson Study Groups (LSGs) similar to those commonly found in Japan (Lewis &

Tsuchida, 1998). We used the multimedia case study *Making Weighty Decisions* (Bowers, Doerr, Masingila, & McClain, 2000) to assist the four cultures in understanding each other's perspectives on mathematics teaching and learning prior to beginning collaborative lesson planning (the first stage in lesson study).

Conceptual Framework

Underlying our examination of discussions of the multimedia case is the notion of mathematics teaching as planning and implementing "mathematical tasks" (Stein, Grover, & Henningsen, 1996). A mathematical task is "a classroom activity, the purpose of which is to focus students' attention on a particular mathematical concept, idea, or skill." (Henningsen & Stein, 1997, p.528). Stein, et al. (1996) developed the mathematical task framework to describe the evolution of tasks from their appearance in curriculum materials to their implementation by students in the classroom (Figure 1).

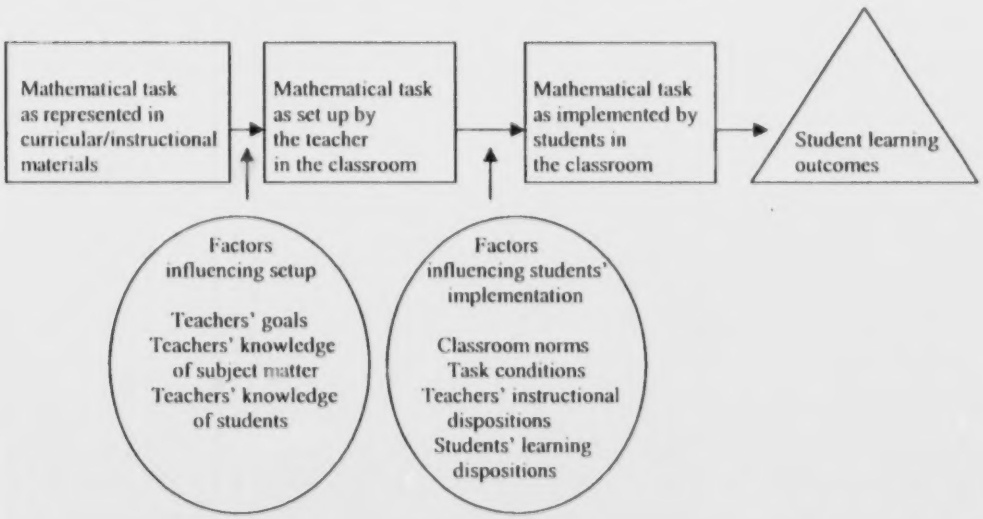
Mathematical task as represented in curricular/instructional materials
Mathematical task as set up by the teacher in the classroom
Mathematical task as implemented by students in the classroom
Student learning outcomes
Factors influencing setup
Teachers' goals
Teachers' knowledge of subject matter
Teachers' knowledge of students
Factors influencing students' implementation
Classroom norms
Task conditions
Teachers' instructional dispositions
Students' learning dispositions

Figure 1. Mathematical Task Framework (adapted from Stein, et al., 1996)

Stein et al. (1996) describe cognitive demand as an important dimension of mathematical tasks. Cognitive demand refers to "the kind of thinking processes entailed in solving the task as announced by the teacher (during the set up phase) and the thinking processes in which students engage (during the implementation phase)." (Henningsen & Stein, 1997, p.529). Tasks set up by the teacher with a high level of cognitive demand encourage students to engage in complex thinking and reasoning such as making conjectures, and justifying and interpreting solutions. However, during implementation in the classroom the level of cognitive demand may decline. Henningsen & Stein (1997) identified several factors associated with the maintenance or decline of high-level tasks in the classroom. Factors associated with the maintenance of high-level tasks include (1) appropriate scaffolding of ideas by the teacher, (2) building on students' prior knowledge, and (3) pressuring students for explanations and justification. Factors associated with the decline of high-level tasks include: (1) reducing challenging aspects of the problem during implementation, (2) providing too much or too little time for students to engage in the problem, (3) shifting the focus from the mathematical concepts and processes to the correctness of the answer, and (4) inappropriateness of the task for a given group of students.

The mathematical task framework, including the maintenance and decline factors, is used in this study to guide our analysis of the online and face-to-face discussions of the multimedia case. This framework is useful to our study for two reasons. First, the framework provides us with a method for describing the activities represented in the multimedia case. Second, the framework provides a lens through which we can interpret participants' comments and consider differences in the contributions of the four cultures

(university mathematicians, in-service teachers, pre-service teachers, and mathematics teacher educators).

Research Questions

1. What are the issues raised by the discussion group members during online and face-to-face discussions of the multimedia case?
2. How, if at all, do the contributions of the members of each culture (university mathematicians, mathematics teacher educators, pre-service mathematics teachers, and in-service mathematics teachers) differ?
3. How do the members of each culture perceive the multimedia case as useful or not useful as a tool for reflection on teaching and learning mathematics?

Methods and Data Sources

Prior to engaging in the multimedia case study, participants engaged in activities designed to acquaint them with various perspectives on mathematics teaching and learning and professional development. Foci included the National Council of Teachers of Mathematics (NCTM) *Principles and Standards for School Mathematics* (NCTM, 2000), lesson study in Japan (Lewis & Tsuchida, 1998), and the mathematical task framework (Stein, et al, 1996). Discussion groups were formed with each group consisting of a high school mathematics teacher, a university mathematician or instructor (a graduate level mathematics student), a mathematics educator, and several pre-service teachers (two to four per discussion group). Each discussion group member was then asked to view the multimedia case individually and then engage in face-to-face and online discussions.

The central components of the *Making Weighty Decisions* multimedia case (Bowers, et al., 2000) are two related mathematical tasks: the "sneaker problem" and "crime statistics problem". Four days of instruction around these problems are represented in video clips of whole-class and small group interaction. The students are eighth graders in a pre-algebra class at a medium sized middle school in large urban school district.

The sneaker problem involves students in developing criteria for purchasing sneakers, ranking the criteria in small groups and then aggregating the rankings of each group into a whole class ranking. In setting up the task, the teacher presents a scenario in which she is going to buy some sneakers and asks students what criteria would be important for her to consider. During implementation, the students are involved in brainstorming criteria factors, working in small groups to rank the brainstormed criteria, sharing rankings, working again in small groups to aggregate the criteria rankings of all groups, and then sharing methods for making the whole group rankings.

The crime statistics problem involves using crime statistics to analyze data, rank data, aggregate ranked data and weight ranks. The teacher sets up the task by presenting information about a debate between the Nashville mayor and the Nashville city council as to whether Nashville is a safe city. The teacher introduces the students to crime statistics in Nashville and several other cities, where the rates are all given per 100,000 people. After introducing the statistics and discussing various crimes, the students rank the cities and explain their methods to the class. After looking at this data, the teacher gives the students another table of crime statistics comparing Nashville with other cities, where the rates are not all per the same number of people. The teacher then asks the students to

devise a system for ranking Nashville with respect to the other cities for this new data. Students work in groups to come up with a method for ranking the crime statistics, perhaps the same as their previous method or a new method. Students share their methods and during the subsequent discussion issues about the notion of rate and weighting averages are raised.

The multimedia case provides the user with many avenues for examining teaching and learning (Figure 2).

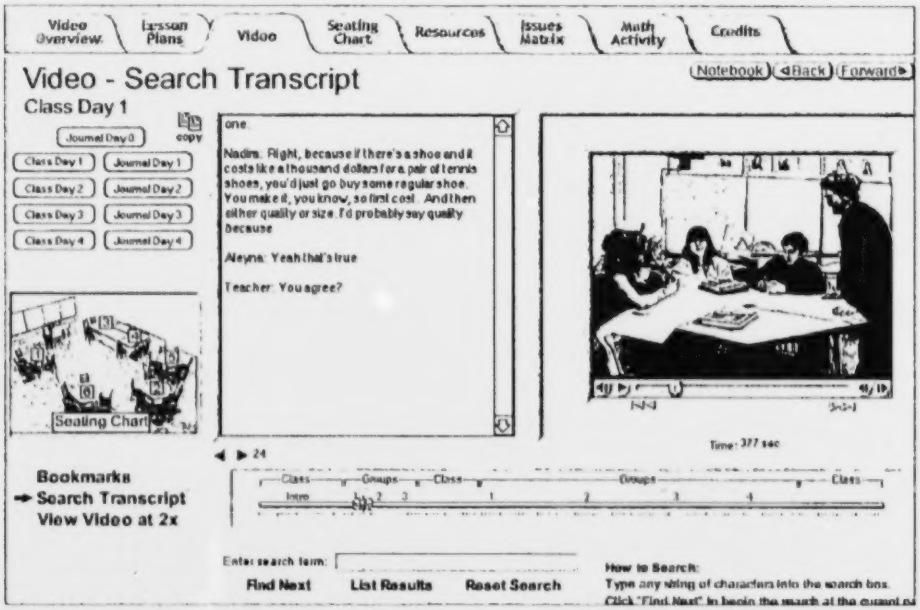

Figure 2. Screenshot of the *Making Weighty Decisions* Multimedia Case (Bowers, et al., 2000)

It first provides a lesson overview explaining how the task is represented in the instructional materials. The video components of the lesson provide the viewer with information about how the task is set up by the teacher and implemented by the students through video of the whole class and four small groups. A journal written by the teacher

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in response to the lesson also provides information about set-up, implementation, and student learning outcomes. Furthermore, evidence of student learning outcomes is evident throughout the video and in the student work section of the multimedia case.

Online discussion prompts were provided initially to encourage discussion group members to reflect on the teacher's role in planning for and facilitating classroom activities, the mathematical content of the lesson, and the level of student thinking throughout the lesson. Members were also encouraged to raise their own issues. Online discussion proceeded for approximately five weeks. Discussion groups met face-to-face to discuss the case study twice during those five weeks; all face-to-face discussions were audiotaped. Post-interviews were conducted approximately two weeks after the conclusion of online discussions. Post-interviews were used for the purpose of collecting information about the perceived usefulness of the multimedia case as well as to determine group members' impressions of the overall lesson study experience in terms of its usefulness as a form of professional development.

Data sources include transcripts of online and face-to-face discussions of the multimedia case for each of four discussion groups and interviews of the 38 participants (a subset of the 38 participants were members of the four discussion groups). Online discussions occurred between September 11th and October 16th, 2000. Face-to-face discussions occurred on September 25th, 2000 and October 16th, 2000.

Data analysis proceeded in two phases. Initially, each of the five researchers examined the transcripts for emergent themes related to the issues raised and contributions of the members of each culture. Next, issues raised during discussions and interviews were mapped onto the mathematical task framework. Researchers worked

individually and then in teams and finally as a whole group, exchanging and then discussing coding to insure inter-rater reliability. After organizing the data with respect to the mathematical task framework, the researchers identified themes of discussion within and across the framework.

The findings presented here derive from a detailed examination of eight face-to-face discussion transcripts (two per discussion group), eight strands of online discussions (two per discussion group), and interviews of the 38 participants. Data analysis to date has focused on identifying issues raised and discussed within the discussion groups (research question #1). At this time we are able to present only initial findings for research questions #2 and #3.

Findings

Topics discussed by group members during online and face-to-face discussion of the multimedia case spanned the categories in the mathematical task framework (see Figure 1). Three topics of discussion were identified that fell outside the mathematics task framework as described by Stein, et al. (1996): factors influencing teachers' choice of tasks, discussion group member dispositions, and usefulness of online versus face-to-face discussions (termed "context of discussion"). It is important to note that discussion context (online or face-to-face) and group member dispositions were both objects of discussion and influences on the discussions. Figure 3 shows a model we developed of the discussion foci which includes both the mathematical task framework and the three additional topics.

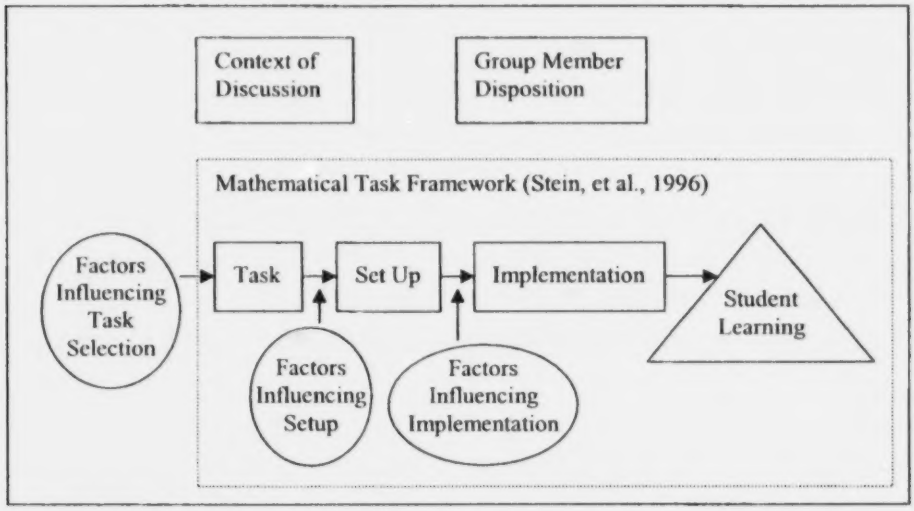

Figure 3. Discussion Foci Based on the Examination of a Multimedia Case of Middle Grade Mathematics Instruction

Overall, both online and face-to-face discussions were dominated by consideration of the ways in which the sneaker and crime statistics problem were implemented by students in the classroom. Discussion moved back and forth between specific references to the actions of the teacher and students and more general comments about issues related to implementation of tasks and factors influencing implementation. There was also substantial discussion across the groups about characteristics of the tasks used by the teacher in the multimedia case and the appropriateness of these tasks for engaging students in thinking about specific mathematical concepts or processes. Discussions of factors influencing the choice of tasks, factors influencing task set up, the way in which the task was set up by the teacher in the classroom, and student learning outcomes occurred less frequently. However, analysis of data collected along these dimensions does provide us with some insights into how the use of a multimedia case

might stimulate consideration of these important issues. In the following sections we describe the substance of the group discussions of the four groups with respect to each aspect of the model above.

Factors Influencing Choice of Task and the Tasks Themselves

Factors influencing choice of task were discussed briefly by two of the four discussion groups. Two concerns related to time were raised. First, how do teachers find the time to locate, develop, and plan for these types of tasks? Second, how do teachers who are required to cover a large number of topics find the class time to devote to an extended activity? One group member was concerned about time with respect to preparing students for the departmental semester exams, but also wondered about the appropriate placement of different kinds of tasks in terms of student knowledge development.

> I think it would be great if we could introduce the concrete then the symbols, students then have something to attach the symbols to. However, everyone does not learn in the same way. I want to know the process then apply it. I wonder if this is the way most people who understand math (math is easy for them) would prefer? Where as, those who struggle with math (math is hard for them) need the concrete before they get the symbols. . . . My experience with most high school students is that they would rather just be shown the process to move on. It would be interesting to see if teaching systems of equations through inquiry/ concrete to symbol, would make a better impression to students than having them see the process and then apply it.

Although issues regarding factors influencing choice of tasks were raised in the online discussions, they did not seem to become the focus of either of the two face-to-face discussions for any of the four discussion groups.

Discussion of the tasks themselves revolved around concerns for motivating students, stimulating the development of multiple solutions, and engaging students with

important mathematics in a meaningful way. Listed below are the specific issues raised during on-line and face-to-face discussions.

- Is the task a real-world task? Is it motivating? Is it too contrived? Do the real-world issues in the task support or constrain engagement with important mathematics in a meaningful way?
- What is the purpose of the task? What is the intended mathematics? Is it important mathematics? Are the mathematical learning goals appropriate for these students?
- Is the task appropriate for the intended mathematics? Is the task mathematically sound?

Many of these issues are tied closely to the level of cognitive demand of the task, for example, the issue of engaging students with "important mathematics in a meaningful way." Questions of motivation and the appropriateness of the task for a given group of students (considering their specific prior knowledge) were also raised. These questions focus attention on issues that have been identified as factors associated with decline in cognitive demand of mathematical tasks (Henningsen & Stein, 1997). Although factors influencing the choice of tasks are not part of the mathematical task framework (Stein, et al., 1996), they seem to be a fairly natural extension of it. Discussion of the tasks themselves and factors influencing the choice of tasks occurred both online and face-to-face with somewhat more discussion occurring online.

Factors Influencing the Set-up of the Task and the Set-up of the Task in the Classroom

Through our analysis of online and face-to-face discussions we identified one topic of discussion related to factors influencing task set up and two topics of discussion related to the task as set up in the classroom. Discussion of factors influencing task set up focused on the teacher's knowledge of subject matter and students, and her ability to be planful as well as responsive in her teaching. Tension between planfulness and responsiveness in teaching was the focus of the following exchange:

Pre-service teacher: It sounds as if the teacher tried not to allow the anticipated student responses to dictate her lesson. If she had allowed what she thought was going to happen in the class dictate the way she was planning the lesson, the lesson would have failed. When you plan a lesson by what you are going to say and then what the students are going to do and how they will react, the lesson will never go as planned and then the teacher will feel like they are not doing an adequate job.

Mathematician: I agree that you need to be careful to make sure your lesson does not hinge on a certain student response/realization; however I think you may have overstated your case. I do think that Professor McClain [the teacher in the multimedia case] used anticipated student responses in planning her lesson. I think it makes absolutely no sense not to do so. You always have to be flexible enough to deal with a surprise, which she did when she suggested to the one group that they use a sum.

The second comment suggests that teachers can be planful but at the same time responsive to students' needs. Consideration of the issues of planfulness versus responsiveness may be particularly useful to preservice teachers who may confuse thoughtful planning with rigidity and unresponsiveness during implementation.

Discussion of the task as set up in the classroom centered on the length of the set up and the level of mathematical activity during the set-up. Discussions about these topics occurred both online and face-to-face. Group members were concerned about the time the teacher spent introducing the sneaker problem. One person stated that "I felt like it took 3/4 of the class period before they actually sat down and tried to sort out these rankings," while another noted that "she [the teacher] realizes she spent too much time talking about shoes." Someone else, however, described how difficult it can be to get students invested in a given task. "I remembered where I was at that age and it's hard to get invested in a problem like that. It might take a little more time." Throughout the discussions tension remained as to the necessary length of task set-up before students

begin actually "doing mathematics." Discussion group members also commented on the lack of mathematical focus during the task set-up as most of the time was spent discussing and ranking the characteristics of shoes that might be important for consumers, rather than using their mathematical knowledge to develop a meaningful aggregate ranking method.

Discussion of teacher planfulness and responsiveness, appropriate length of task set-up, and the level or amount of mathematics involved in the set-up seemed to be stimulated by viewing of the multimedia case. With respect to the mathematical task framework, planfulness involves knowledge of students and subject matter as well as attentiveness to goals for student learning (two of the factors influencing task set-up). Responsiveness may be thought of as an instructional disposition that teachers can cultivate, allowing them to alter their plans as necessary during implementation. The length and degree of mathematical focus during the set-up are both factors that may influence the level of cognitive demand of the task as set up by the teacher in the classroom. The level of cognitive demand during set-up influences the level of cognitive demand during implementation, and ultimately, student learning outcomes.

Factors Influencing Students' Implementation

With respect to factors influencing implementation, discussion centered on teachers' instructional dispositions and students' learning dispositions. Participants in one group focused on how the teacher in the multimedia case seemed to run out of time at the end of one of the class periods. Students left the classroom without coming to consensus about the best method(s) for solving the task at hand. Some of the group members admitted to feeling uncomfortable about the way the class period ended. They

commented "I kind of like the sitcom classroom, where it wraps up at the end" and "I definitely feel flustered if it ends like that . . . there's something missing". Other members of this group described experiences they had teaching in more "chaotic" learning environments, such as computer labs, where students work at varying paces without a comfortable wrap-up at the end of each period. One group member suggested that class discussions could be planned for the beginning of the next day, in order to alleviate the pressure on the teacher to wrap things up at the end of class. The discussion of this group suggests that watching how the teacher in the multimedia case ended the class period stimulates thinking about one's own instructional dispositions.

Group members discussed several ways in which student learning dispositions influence the implementation of mathematical tasks in the classroom. General comments about students' low tolerance for uncertainty, their desire for teacher direction, and their unwillingness to use each other's comments and explanations as thinking devices were a frequent topic of discussion.

> One thing that I think both of you are saying is that your students have these beliefs about mathematics, that there's a right answer and a right way to do it, and so you're saying that the students won't want to listen to each other because they don't think that each other knows the answer, right? . . . That's like one of the things where you have to, I mean those come from the culture and so you have to change their beliefs, which is really hard but you just have to work on it over and over, right? That's your problem in the classroom. That's my problem in the classroom, too.

The group members also related these general issues back to the multimedia case, one member commenting that although the teacher had indicated in her journal that she didn't want to be the intermediary between the student(s) presenting and the rest of the class, this seemed to happen in the video clip. "She would kind of like explain things [after the

students explained them] and then she had to ask the class if there were questions [for the student presenters] and they kind of looked everywhere. That happens a lot."

As described above, discussion of factors influencing students' implementation had two primary foci: teacher instructional dispositions and student learning dispositions. Discussions of these issues occurred both online and face-to-face. With respect to teacher instructional dispositions, discussion focused on how a teacher's desire for closure at the end of each class period can lead to a discomfort when time runs out. In terms of student learning dispositions, group members discussed how students' beliefs about the nature of mathematics and, in particular, school mathematics, affect what happens in the classroom. All of these issues can influence the level of cognitive demand of a task as it is implemented in the classroom and several of these issues are closely related to the factors associated with the decline of high-level tasks as described by Henningsen and Stein (1997).

Task as Implemented by Students in the Classroom

Discussion of task implementation focused mainly on teacher-student and student-student interaction. With respect to teacher-student interaction, members of all four discussion groups commented on the ways in which the teacher in the multimedia case seemed to "take over" thinking and reasoning for the students and pushed them to use certain methods to make sense of the data. Group members seemed to agree that knowing when and how much to lead students in certain directions is a frequent problem for teachers and concerns with time constraints often cause teachers to do too much telling. Group members frequently disagreed, however, over how much guiding is too

much and debated about whether or not specific segments of video clip showed a teacher giving just enough or too much guidance.

Discussion group members described several ways in which the teacher in the multimedia case attempted to maintain a high level of cognitive demand during her interactions with students. Various strategies used by the teacher were identified including asking students to explain their solution methods, encouraging students to convince each other of their ideas, and pushing for justification and reasoning. Group members also noted that sometimes the teacher's efforts fell short. The following comment is very typical of those made during both online and face-to-face discussions.

> I think she always wants them to understand what they are doing and why. In every interaction with the groups that she has, she always has them explain to her what they are doing, even if they have figured out the problem correctly. She does have a tendency to quickly try to change their way of thinking if it is in the wrong direction, but I probably would too if I was in her situation.

Eventually discussion of this teacher's actions led to the question "what would you do differently?" Suggestions included allowing students more time to work on the task, allowing students to pursue their own ways of thinking during group time, and developing an additional task that would push students' thinking.

Discussion of student-student interaction focused on the degree to which group interactions supported or inhibited student thinking. Several people noted instances in the multimedia case where one group member did most of the thinking or group members did not seem to be listening to and trying to understand each other's ways of thinking. Comments such as these led to discussions about various methods of grouping and the usefulness of grouping in general. Issues raised included the extent to which students

should be expected to depend on each other for the development of mathematical understandings and the potential usefulness of homogenous and heterogeneous groups.

Teacher-student interaction, including questioning strategies and the appropriate level of guidance, were topics of discussion for all four groups. The appropriateness of the amount of time provided for students to wrestle with the task was also questioned. Student-student interaction and its affect on the level of thinking of individual students were also considered. Discussions of these issues occurred both online and face-to-face. With respect to the mathematical task framework, these are issues of critical importance to the maintenance of high-level cognitive demand during task implementation.

Student Learning Outcomes

Group discussion related to student learning took two forms, comments about the specific learning that did or did not seem to come out of the lessons in the multimedia case and comments about the more general issues of assessment and student learning goals and how to reach them. Discussion of student learning occurred both online and during face-to-face meetings. With respect to specific learning outcomes, group members remarked:

> [A student] says something like he added 5 plus 1 plus 1 plus 4 and while he does that he comments that doing so brings the average way down. I took that as a good sign that he conceptually understood what happens when taking the averages.

> With [the sneaker] lesson, I think the students might realize why the method of summing up the ranks works, but don't understand necessarily why picking the majority at each stage is not the correct way of attacking the problem.

Other group members were concerned with what they viewed as a lack of high-level thinking. "My basic argument is that students aren't doing much of the connecting,

analyzing, representing, organizing, and manipulating that I see as the crux of 'doing mathematics.'"

The more general comments made by discussion group members proved quite provocative. Consider the following statement made by a university mathematician in response to another group member's statement expressing concern with some students' using calculators to add and divide relatively small numbers.

> I want to disagree that if students are not good at quickly adding and dividing, they cannot understand averages. The average is a concept that makes use of adding and dividing. As long as a student understand the concepts of adding and dividing, they can understand average. . . . Some people understand and can compute, some memorize the steps for doing the computation, but don't understand, some understand but can't transfer that into successful computation and some neither understand nor compute correctly. Okay. Go ahead and bombard me now with messages on how computation is essential (I'm not sure I disagree.) and if you can't translate understanding to computation, it shouldn't count as understanding. But be sure to include in your message what should actually count as understanding. (That is the fundamental issue.).

We agree that this is a critical issue with which mathematics educators/teachers struggle. What is the relationship among procedures and concepts? In addition, how do we know if a student truly understands? In fact, what is mathematical understanding?

A final theme related to student learning focused on the difficulty of using "discovery learning" to build mathematical understanding. Tension was expressed between engaging students in discovery lessons with a variety of learning outcomes and the development of "common knowledge." Discussion group members raised questions about the extent to which common knowledge can be developed when students are pursuing different paths and reaching different points along their paths. One member wrote, "I mean, we basically want common knowledge, but on the other hand, we want

students, the student generated ideas to drive the curriculum, but yet we want common knowledge."

Discussion about student learning seems closely linked to discussion of the tasks themselves and factors influencing the choice of tasks. This makes sense, since many of the discussion group members began the process by considering the teacher's mathematical goals for the lessons and the appropriateness of the chosen tasks for these goals. With respect to the mathematical task framework, some group members tied student learning to the level of cognitive demand of the task during implementation and to the teacher's goals for instruction (a factor influencing the set-up of the task).

Context and Group Member Disposition

Discussion with respect to "context" focused on difficulties and benefits of using an online discussion forum. One discussion group member commented that "you can post but then you have to wait for a response, . . . you're really dependent on other people's time factors", while another member responded "on the other hand it's good because lots of times when you're having conversations people just say nonsense because they haven't thought about it". Most group members seemed to agree that writing posts and reading other people's posts stimulated their thinking, but also felt that they never achieved real "discussion" online. Lag time between online postings and face-to-face discussions seemed somewhat problematic, as discussion group members spent time during face-to-face meetings trying to recall the substance of their group's online postings.

Discussion focusing on group member dispositions involved descriptions of which aspects of teaching and learning captured group members' interests as they

examined the multimedia case. Some members stated that they tended to focus on the way the teacher orchestrated the activities, while others said they focused on student-student interaction or the various methods students developed to solve the tasks. Several participants indicated that they focused on things that were somehow linked to their own teaching.

> Mathematician: My role was to look for mathematics, but that's not what I was most interested in. I was most interested in watching the teacher and seeing what she did to facilitate the group interaction . . . because this semester in the class that I am working with my duties are to get the groups set.
>
> In-service teacher: When I was watching [the video clips] I wanted to . . . make some comments about group work because some of the people who came and were observing me, they were asking me my ideas of group work and, actually, I saw what was happening [in the video clips] as just partners, . . . people working toward a common goal, and that's not what I consider true group work.

In addition, a few of the pre-service teachers expressed their discomfort with critiquing an in-service teacher and their desire for some "ideas for what could or should have been done to improve on these lesson plans."

It seems important to consider both group member disposition and the context of the discussions to better understand both the sense that the participants are making of the multimedia case and the impact the process is or is not having on their beliefs and practices. Analysis of the contributions and dispositions of individual discussion group members is an important next step for our research process.

Contributions of Members by Culture and Perceived Usefulness of the Multimedia Case

Data analysis is on-going and we present only initial findings here with respect to the second and third research questions. The contributions of group members (university

mathematicians, mathematics teacher educators, pre-service mathematics teachers, in-service mathematics teachers) seem to show some variation. Both in-service teachers and mathematicians drew heavily on their own experiences as teachers. They related the multimedia case to personal experiences, especially during the face-to-face discussion. The mathematics teacher educators seemed to act as discussion facilitators as well as participants. They frequently asked questions such as 'What other questions should/could [the teacher] ask?' and 'Do you think that times exist when thinking about how students will do the task leads a teacher to limit the possible paths that students may take in solving a problem?' in an apparent effort to push the discussion past mere descriptions of what occurred. Pre-service teachers' voices were sometimes tentative, prefaced with 'I think' or 'I'm not sure but'. Also, pre-service teachers questions were often of a type different than those posed by the mathematics educators and others. Pre-service teachers sought advice from other group members with statements/questions such as 'I was wondering how you would handle any of these situations' or 'Would you let your students struggle or go on?' Comparing the contributions of group members with the mathematical task framework, we found that the contributions of all members tended to focus on managing task implementation and problems frequently encountered as teachers attempt to maintain a high level of student engagement and thinking.

During the interviews, participants were asked for both positive and negative reactions to the multimedia case study. Participants described many benefits including (1) the sharing of multiple perspectives around a single instance of practice, (2) the opportunity to think more deeply about teaching and learning, (3) the ability to observe and critique someone else's teaching (to be 'on the other side' of the camera for a while).

Many participants preferred face-to-face discussions to online discussions because of the lag in response time during online discussions. (Note: online discussions consisted of a series of postings rather than a chat room.)

Conclusion

The results of our examination of online and face-to-face discussions of group members about a complex, multimedia case of teaching mathematics reveal some interesting relationships to the mathematical task framework that guided the analysis of the data. The framework was originally developed as a tool for researchers to analyze instruction, not talk about instruction. However, our analysis suggests that it is a useful tool for examining the substance of discussions about teaching and learning. The participants of discussion groups, which consisted of in-service and preservice secondary mathematics teachers and university mathematicians and mathematics teacher educators, generally touched on all aspects of the mathematical task framework in their discussions. Both the characteristics (including cognitive demand) of tasks at all stages of instruction and the factors influencing the levels of the tasks were analyzed by participants. In addition, participants reflected on their own values and beliefs and related what they viewed in the multimedia case to their own teaching and learning experiences. Use of the mathematical task framework allowed us to see the depth and breadth of the discussions held both online and face-to-face.

In 1988, Marx and Walsh wrote:

> Our major theme has been that the improvement for instruction rests to a large degree on a better understanding of the complex nature of classroom work. Such an understanding must begin with a descriptive theory of academic work, a theory that embraces the conditions, products, and cognitive plans that are the major constituents of this work. Ultimately, of course, a coherent theory of classroom tasks must lead to guidelines for

> instruction....Teachers must also structure the setting and social context in which a task is completed to ensure that these factors do not sabotage the teacher's intent for the task. (p. 217)

The potential for multimedia case studies to assist members of the mathematics education community in reflecting on practice is just beginning to be examined. This study contributes uniquely to the literature by considering how a multimedia case is utilized by discussion groups with diverse membership (in-service mathematics teachers, university mathematicians, pre-service mathematics teachers, and mathematics teacher educators). Future research is needed to better understand how members of groups such as these contribute to and benefit from the use of multimedia case studies to reflect on practice.

References

Barron, L., & Goldman, E. (1994, November). *Integrated media in preservice teacher education to explore children's mathematical learning.* Presentation of the annual meeting of Psychology of Mathematics Education-North America, Baton Rouge, LA.

Bowers, J. S., Doerr, H. M., Masingila, J. O., McClain, K. (2000). Multimedia case studies for teacher development: Case II: Making weighty decisions (Version 1.0) [CD-Rom]. New York: Syracuse University.

Henningsen, M., & Stein, M. K. (1997). Mathematical tasks and student cognition: Classroom-based factors that support and inhibit high-level mathematical thinking and reasoning. *The Journal For Research in Mathematics Education, 28* (5), 524-549.

Lampert, M. & Ball, D. (1998). *Teaching, multimedia, and mathematics: Investigations of real practice.* New York: Teachers College Press.

Lewis, C. C. & Tsuchida, I. (1998). A lesson is like a swiftly flowing river: How research lessons improve Japanese education. *American Educator, 22* (4), 12-17 and 50-51.

Marx, R. W., & Walsh, J. (1988). Learning from academic tasks. *The Elementary School Journal, 88* (3), 207-219.

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics.* Reston, VA: Authors.

Stein, M. K., Grover, B. W. & Henningsen, M. (1996). Building student capacity for mathematical thinking and reasoning: An analysis of mathematical tasks used in reform classrooms. *American Education Research Journal, 33,* 455-488.

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